A deep VLT survey for the host galaxies of dark GRBs

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Abstract: *We report on the results of a deep VLT imaging campaign to search for the host galaxies of dark GRBs.*

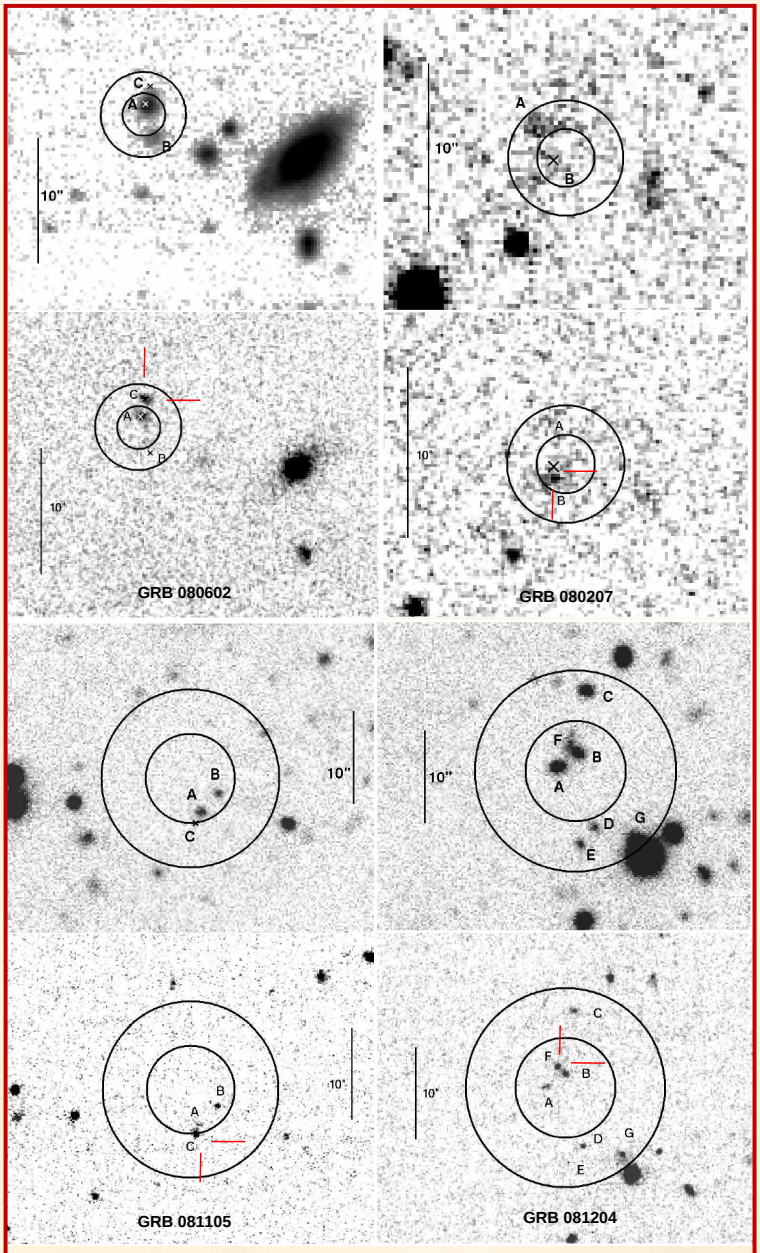

Figure 1: Four of the seven EROs found in our sample (Rossi et al. 2012). The inner circle is the 90% c.l. X-ray error circle (1.6 sigma). The outer circle has twice the radius (99.9%).

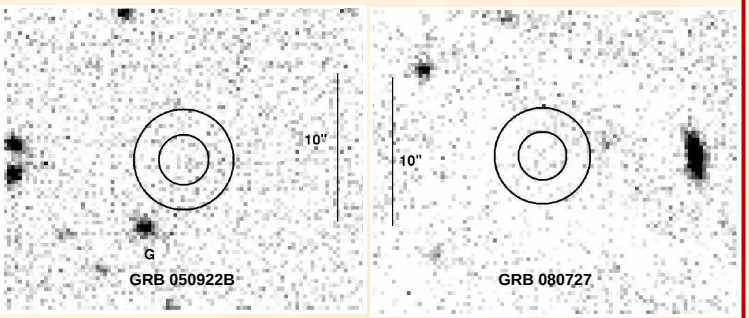

Figure 2: No galaxy is found in the X-ray error circles of GRB 050922B and GRB 080727A down to R,K = 26,23 (radius r=1.7 and 1.6 arcsec, resp.).

What are optically dark bursts?

Several GRBs with detected X-ray afterglow have no detected optical afterglow, despite deep and rapid follow-up observations. These are optically dim bursts. Some are even fainter than expected based on their observed X-ray flux; these events are called dark bursts (Jakobsson et al. 2004).

Why are these bursts of interest?

If no optical afterglow is known, we are left with arcsec-sized X-ray error circles and no GRB host galaxy is identified. However, these galaxies are of interest, because the lack of optical flux in an afterglow can point to (a) cosmological Lyman drop out in the optical bands, i.e., high redshift, or (b) substantial extinction in a very dusty host.

A deep VLT imaging campaign

We used FORS1, FORS2, VIMOS, ISAAC, and HAWK-I to look deep into the arcsec-sized X-ray error circles of 14 optically dim and dark bursts with the goal to search for their host galaxies. All bursts are long bursts, i.e., related to the death of massive stars.

Discovery of dust-enshrouded galaxies

In seven cases, we detected an extremely red object (ERO; defined as (R-K)_AB > 3.5 mag) inside the 90% c.l. X-ray error circle **(Fig. 1).** In all cases the probability to find an ERO in such a small region of the sky is <10%, suggesting that these are the host galaxies we have been looking for. This implies that optically dim bursts trace a population of globally dust-enshrouded galaxies. In fact, some of them are submm bright(Hunt et al. 2012; Svensson et al. 2012).

E-ELT targets 2018+

In two cases, GRBs 050922B and 080727A. we could not find any galaxy inside the X-ray error circle. Any host galaxy must be fainter than R=26 and K=23 **(Fig. 2).** This makes these objects to potential targets for the E-ELT, because any long burst implies that there is an underlying star-forming host. Given the optical dimness of these afterglows, these galaxies are good candidates for lying at very high redshift.

References: Hunt, L. et al. 2012, ApJ 736, L36; Jakobsson, P. et al. 2004, ApJ 617, L21; Rossi, A. et al. 2012, Astron. Astroph., accepted; Svensson, K. M. et al. 2012, MNRAS 421, 25